

Shell boilers —

Part 4: Workmanship and construction of pressure parts of the boiler

The European Standard EN 12953-4:2002 has the status of a
British Standard

ICS 27.060.30; 27.100

National foreword

This British Standard is the official English language version of EN 12953-4:2002. It partially supersedes BS 2790:1992 which will be withdrawn on publication of BS EN 12953 Parts 1, 2, 3, 4, 5, 6, 8 and 9.

When the reference to this European Standard has been published in the Official Journal of the European Communities (OJ), compliance with it will confer a presumption of conformity with the essential requirements covered by the standard in respect of the Pressure Equipment Directive.

The UK participation in its preparation was entrusted to Technical Committee PVE/16, Shell boilers, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 44, an inside back cover and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

This British Standard, having been prepared under the direction of the Engineering Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 14 June 2002

© BSI 14 June 2002

ISBN 0 580 39850 1

ICS 27.060.30; 27.100

English version

Shell boilers - Part 4: Workmanship and construction of pressure parts of the boiler

Chaudières à tubes de fumée - Partie 4: Fabrication et construction des parties sous pression des chaudières

Großwasserraumkessel - Teil 4: Verarbeitung und Bauausführung für drucktragende Kesselteile

This European Standard was approved by CEN on 15 May 2002.

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Foreword

This document (EN 12953-4:2002) has been prepared by Technical Committee CEN/TC 269 "Shell and water-tube boilers", the secretariat of which is held by DIN.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2002, and conflicting national standards shall be withdrawn at the latest by November 2002.

This European Standard EN 12953 concerning shell boilers consists of the following Parts:

- *Part 1: General.*
- *Part 2: Materials for pressure parts of boilers and accessories.*
- *Part 3: Design and calculation for pressure parts.*
- *Part 4: Workmanship and construction of pressure parts of the boiler.*
- *Part 5: Inspection during construction, documentation and marking of pressure parts of the boiler.*
- *Part 6: Requirements for equipment for the boiler.*
- *Part 7: Requirements for firing systems for liquid and gaseous fuels for the boiler.*
- *Part 8: Requirements for safeguards against excessive pressure.*
- *Part 9: Requirements for limiting devices of the boiler and accessories.*
- *Part 10: Requirements for boiler feedwater and boiler water quality.*
- *Part 11: Acceptance tests.*
- *Part 12: Requirements for firing systems for solid fuels for the boiler.*
- *Part 13: Special requirements for stainless steel boiler servicing sterilizer.*

CR 12953-14: Guidelines for the involvement of an inspection body independent of the manufacturer.

Although these Parts can be obtained separately, it should be recognized that the Parts are inter-dependent. As such, the design and manufacture of shell boilers requires the application of more than one Part in order for the requirements of the standard to be satisfactorily fulfilled.

Annex A of this European Standard is informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This Part of this European Standard specifies requirements for the workmanship and construction of shell boilers as defined in EN 12953-1.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 287-1, *Approval testing of welders - Fusion welding - Part 1: Steels.*

EN 288-3, *Specification and approval of welding procedures for metallic materials - Part 3: Welding procedure tests for the arc welding of steels.*

EN 1011-2, *Welding - Recommendations for welding of metallic materials - Part : Arc welding of ferritic steels.*

EN 1418, *Welding personnel — Approval testing of welding operators for fusion welding and resistance weld set-
ters for fully mechanized and automatic welding of metallic materials.*

prEN 10216-2, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2: Non-alloy
and alloy steel tubes with specified elevated temperature properties.*

prEN 10217-2, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 2: Electric
welded non-alloy and alloy steel tubes with specified elevated temperature properties.*

prEN 10217-5, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 5: Submerged
arc welded non-alloy and alloy steel tubes with specified elevated temperature properties.*

EN 12953-1:2002, *Shell boilers - Part 1: General.*

EN 12953-3:2002, *Shell boilers — Part 3: Design and calculation for pressure parts.*

EN 12953-5:2002 *Shell boilers — Part 5: Inspection during construction, documentation and marking of pressure
parts of the boiler.*

3 Terms and definitions

For the purposes of this European Standard the terms and definitions given in EN 12953-1 shall apply.

4 Symbols

For the purposes of this European Standard the symbols given in EN 12953-1:2002, Table 4-1 shall apply.

5 General requirements

5.1 General

5.1.1 The rules in this Part are applicable to all aspects of fabrication, including welding, of boilers and boiler parts, and shall be used in conjunction with the specific requirements applicable to the grades of materials used.

5.1.2 All welding shall be in accordance with the requirements of this standard.

5.1.3 For category II, III and IV boilers, all welders or welding operators and welding procedures shall be approved (see 5.15.3). For category I boilers, approval shall not be mandatory.

5.1.4 The manufacturer of a boiler, or boiler part, built in accordance with the requirements of this European Standard, shall be responsible for the welding done by his workmen. The manufacturer shall designate a competent welding supervisor and also conduct the tests for the approval of the welding procedures used. No production work shall be undertaken on category II, III and IV boilers until both the welding procedures and the welders or welding operators have been approved (see 5.15.3).

5.1.5 The manufacturer shall maintain a record of the results of welding procedure and welding approval tests.

5.1.6 The welds made by each welder shall be marked with a stamp showing the welder's identity or some other appropriate record shall be made. If hand stamping is employed, only low-stress stamps shall be used.

NOTE Low-stress stamps are those with radiused edges or those making a series of dots.

5.1.7 If, during the construction of a boiler or pressure part, the work is not satisfactory or is not in accordance with the requirements of this European Standard, the causes shall be investigated by the manufacturer and rectified. If necessary, requalification tests shall be undertaken and this shall be recorded.

5.2 Material identification

In laying out and cutting the material, the material identification shall be so located as to be clearly visible when the pressure part is completed. Alternatively, for materials that cannot be stamped, or for small multiple parts, or non-pressure parts, the manufacturer shall operate a documented system that ensures material traceability for all materials in the completed boiler. If the material's identification is unavoidably cut out during manufacture, it shall be transferred by the pressure part manufacturer to another part of the component. The transfer of the identification shall be carried out by a person designated by the manufacturer. The method of transferring the original identification shall not contravene the requirements of the material specification.

5.3 Cylindrical shells

5.3.1 Each ring shall be formed from not more than two plates, bent to cylindrical form to the extreme ends of the plate. The bending shall be performed entirely by machine, and local heating or hammering shall not be used.

5.3.2 The shell of completed boilers shall be in accordance with the following requirements.

a) Straightness

Unless otherwise shown on the drawing, the maximum deviation of the shell from a straight line shall not exceed 0,3 % both of the total cylindrical length and of any 5 m length. Measurements shall be made to the surface of the parent plate and not to a weld, fitting, or other raised part;

b) Irregularities in profile

1) Gradual local departures from circularity

Irregularities in profile (checked by a 20° gauge) shall not exceed 2 % of the gauge length.

NOTE This maximum value can be increased by 25 % if the length of the irregularities does not exceed one quarter of the length of the shell part between two circumferential seams, with a maximum of 1 m. Greater irregularities require proof by calculation or strain gauge measurement that the stresses are permissible.

2) Peaking at welded seams

If an irregularity in profile occurs at the welded seam and is associated with "flats" adjacent to the weld, the irregularity in profile or "peaking" shall not exceed the values given in Table 5.3-1.

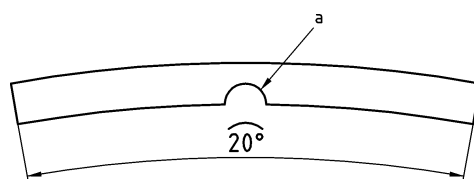
Table 5.3-1 — Maximum permitted peaking for dynamic and cyclic loads

Dimensions in millimetres

Wall thickness e	Maximum permitted peaking
$e < 3$	1,5
$3 \leq e < 6$	2,5
$6 \leq e < 9$	3,0
$9 \leq e$	$e/3$

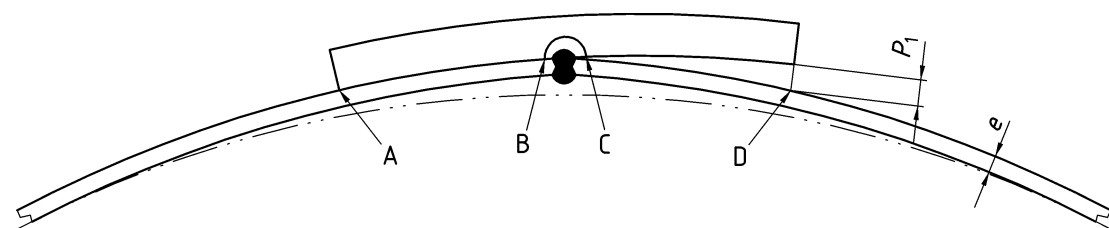
A conservative method of measurement (covering peaking and ovality) shall be by means of a 20° profile gauge or template.

The use of such a profile gauge shall be in accordance with Figure 5.3-1. Two readings shall be taken, P_1 and P_2 , on each side of the seam at any particular location, the peaking is taken as being equivalent to $0,25 (P_1 + P_2)$, or P_3 .

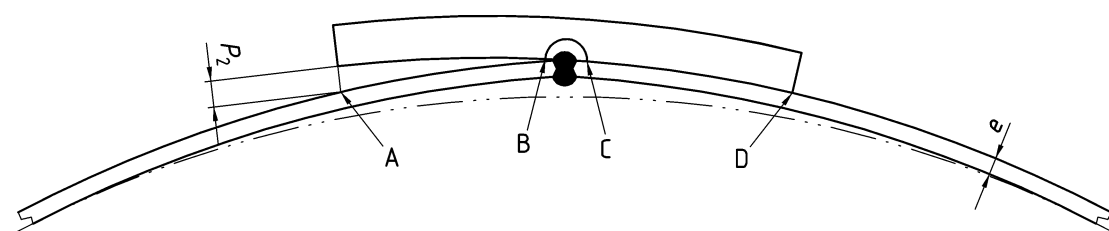
**Key**

- a Cut out in gauge to clear weld reinforcement

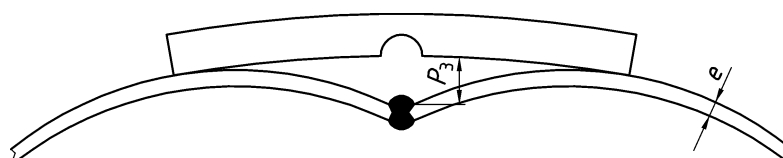
a) 20° profile gauge



b) Reading 1



c) Reading 2



d) Negative peaking (flat)

Figure 5.3-1 — Profile gauge and its method of use**c) Departure from circularity**

The difference between the maximum and minimum internal diameter of any section of a shell welded longitudinally shall not exceed $(D+1250)/200$, where D is the nominal internal diameter expressed in millimetres.

Measurements shall be made to the surface of the parent plate and not to the weld, fitting or other raised part.

Shell sections shall be measured for departure from circularity either when laid flat on their sides or when set up on end. If the shell sections are checked when laid flat, each measurement for diameter shall be repeated after turning the shell through 90° about its longitudinal axis. The two measurements for each diameter shall be averaged to give the out-of-roundness.

Any local departure from circularity shall be gradual.

d) Cold rolling

Cold rolling of a welded shell to rectify a small departure from circularity shall be permitted, provided that non-destructive testing conforming to EN 12953-5:2002, 5.3 is carried out after the departure from circularity has been remedied.

5.4 Tell-tale holes

Reinforcing plates and saddles of nozzles attached to the outside of a boiler shall be provided with at least one tell-tale hole that may be tapped (maximum size G ¼) for a preliminary leakage test for tightness of welds that seal off the inside of the boiler. These tell-tale holes may be left open or may be plugged when the boiler is in service. If the holes are plugged, the plugging material used shall not be capable of sustaining pressure between the reinforcing plate and the boiler wall.

5.5 End plates and tube plates

If practicable, flat or dished ends shall be made in one piece except that, where the diameter is so large as to make this impracticable, flat ends may be made from two plates butt welded together (see Figure A.1). The weld shall be located preferably between two rows of bar stays or, if there is only one row of bar stays, between this row and the top row of stay tubes.

Dished end plates and flanging of flat end plates shall be produced either by pressing or spinning. The cylindrical skirt shall have a good surface condition and shall be free from local irregularities.

Cold forming of flat flanged end plates, tube plates and dished ends shall be permitted in accordance with an agreed approved procedure, including normalising, if required.

Hot forming of plates that have been dished or flanged at non-uniform temperatures, or that have been locally heated, shall be normalized after forming unless the manufacturer can demonstrate that the safety of the component is not affected.

Where hemispherical shell end plates are pressed from one plate, they shall be pressed to form by machine in progressive stages, and shall be normalised on completion.

NOTE Normalising can be omitted for hot formed ends, when the forming process is completed at temperatures within the normalising range.

5.6 Plain tubes and stay tubes

5.6.1 Tubes shall be expanded or welded into the tube plate, or secured by a combination of both methods.

5.6.2 If the tubes are fully expanded only, the process shall be carried out with roller expanders, and the expanded portion of the tube shall be parallel throughout the full thickness of the plate.

5.6.3 In addition to expanded tubes, flared tubes, bell-mouthed tubes or beaded tubes shall be permitted.

5.6.4 If tubes are welded to the tube plate by welds other than full penetration welds, the unwelded portion of the tube within the tube hole shall be lightly expanded to provide full contact with the tube plate, except as permitted otherwise in EN 12953-3:2002, 6.1d).

5.6.5 If stay tubes are not provided, the ends of the tubes shall be welded or expanded and beaded at the inlet end and welded or expanded only at the outlet end.

5.6.6 Welding of tubes shall be permitted after stress relief of the boiler.

5.7 Manhole frames and openings

5.7.1 Jointing flanges

The jointing flanges of openings and covers shall be machined on the face and edges and on the bearing surface of the bolt heads and nuts. Bolts and nuts shall be machined where they are in contact with the flanges.

5.7.2 Doors

Doors shall be constructed in accordance with the following requirements.

- a) Doors shall be formed to fit closely to the internal joint surface and shall be fitted with studs, nuts and cross bars;
- b) The spigot part, or recess, of manhole and sight-hole doors shall be as neat a fit as practicable. However, in no case shall the clearance all round exceed 1,5 mm;
- c) Nuts shall be compatible with the studs.

5.8 Connections for mountings

5.8.1 Mountings

Screwed mountings (valves etc) over 25 mm internal diameter and flanged mountings greater than DN 80 shall not be attached directly to any boiler plate, but shall be attached to suitably forged, cast or fabricated nozzles.

NOTE Alternatively, nozzles can be in the form of either screwed or studded pads, forged or cut from plate or round bar.

5.8.2 Pads

Nozzles in the form of pads in contact with the boiler shall be formed to fit closely to the plate to which they are to be attached.

If pads are used, the jointing surfaces shall be machined. The pads shall have sufficient thickness to allow the drilling of the stud holes for mountings without the inner surface being pierced and the length of the screwed portion of the stud in the pad shall be not less than the diameter of the stud.

5.8.3 Nozzles

If nozzles are used, the flanges shall be machined or thermal-cut by machine on the edges. The bolting flanges shall be machined on the jointing and bolting surfaces.

5.8.4 Screwed mountings

Screwed mountings not exceeding DN 80 bore shall be fitted to screwed nozzles welded to the boiler. Mounting shall be able to withstand the operating pressure and temperature of the boiler.

5.9 Cylindrical furnaces

5.9.1 Each section of a cylindrical or conical furnace shall be made from one plate. If this is not possible, no more than two plates shall be used. The longitudinal welds shall be at least 120° apart and shall be full penetration butt welds in accordance with 5.12. Alternatively, furnaces shall be made from tubes to prEN 10216-2, prEN 10217-2 or prEN 10217-5. The tensile strength and minus tolerances on thickness shall be taken into account.

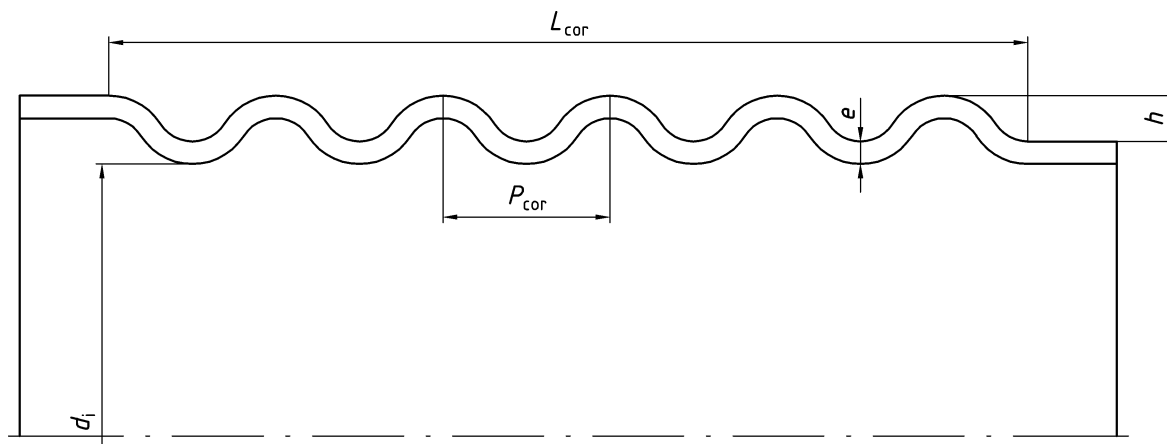
NOTE The welding procedure and the welder/operator for welded tubes in accordance with prEN 10217-2 or prEN 10217-5 are to be approved by the notified body.

5.9.2 Finished plain or corrugated furnace tubes shall be subjected to an internal and an external inspection, especially the welds and weld-adjacent zones.

5.9.3 For plain furnaces, the manufacturing tolerance on diameter shall be ± 5 mm. For corrugated furnaces, the manufacturing tolerance shall be as given in Table 5.9-1. Out of roundness (see 5.3.2 c)), shall not exceed 1 % for corrugated furnaces or 1,5 % for plain furnaces. Any departure from circularity shall be gradual.

Table 5.9-1 — Manufacturing tolerances for corrugated furnaces

Symbol	Definition	Limit deviations mm
d_i	Internal diameter	+ 5, - 20
e	Plate thickness	± 2
L_{cor}	Total length of corrugation	± 25
P_{cor}	Pitch of corrugation	± 5
h	Height of corrugation	± 10
See Figure 5.9-1		



Key

- d_i internal diameter
- e plate thickness
- h height of corrugations
- L_{cor} total length of corrugations
- P_{cor} pitch of corrugations

Figure 5.9-1 — Corrugated furnaces

5.9.4 The longitudinal welds of furnaces shall be placed in such a position that they can be examined from the water side in accordance with inspection category 2 of EN 12953-3.

5.9.5 Corrugated furnaces and bowling hoops shall be produced by machine. They shall be normalised unless the manufacturing process is carried out above the normalising temperature.

5.9.6 If stiffeners are required, they shall be attached externally by continuous full penetration welds.

5.9.7 Forms of furnace connections to end plates are shown in Figure A.15. Where the furnace is inserted into a hole in the end plate, it shall be a good fit around the whole periphery.

5.10 Water-cooled reversal chamber

The reversal chamber tube plates and end plates shall be welded to the wrapper plate, e.g. Figure A.14.

5.11 Stays

5.11.1 Bar stays

All bar stays shall be made from a solid rolled bar without a weld in its length, except those attaching the bar stays to the plates they support.

Bar stays that have been hot worked shall be subsequently normalized.

If a stay is in position in the boiler, its axis shall be normal to the plate it supports.

A tell-tale hole shall be drilled along the axis of all bar stays. The nominal diameter of the hole shall not exceed 5 mm and the drilling shall extend a minimum of 15 mm beyond the water surface of the plate.

5.11.2 Girder stays

The attachment of girder stays welded directly to the crown plates shall be by means of full penetration welds.

5.11.3 Tube stays

Tube stays shall be made from seamless or welded tube.

NOTE If appropriate, tube stays can be fitted in accordance with the requirements of bar stays as given in 5.11.1.

5.12 Design of welded joints

5.12.1 Weld deposition

The design of the welded joints shall be such as to provide adequate access to enable the deposition of weld metal to meet the requirements laid down in this European Standard.

5.12.2 Weld crosses

5.12.2.1 Pressure parts

Joints shall not be permitted where more than two welded seams meet at one point.

If a component is made of two or more shell sections, the longitudinal seams shall be completed before commencing the adjoining circumferential seam(s). The longitudinal seams of each adjacent section shall be staggered by at least 100 mm and they should, if possible, be located in the top half of the boiler (i.e. between 9 and 3 o'clock of the circumference).

5.12.2.2 Non-pressure parts

Attachment of non-pressure parts by welds that cross, or for which the minimum nominal distance between the edge of the attachment weld and the edge of the existing main welds or nozzle welds is less than twice the thickness of the pressure part, or 40 mm, whichever is the smaller, shall be avoided.

If such welds cannot be avoided, they shall cross the main weld completely rather than stopping abruptly near the main or nozzle weld in order to avoid stress concentrations in these areas.

5.12.3 Properties

The material properties of all pressure parts shall not be adversely affected by the welding of nozzles, pads, branches, pipes, tubes, and non-pressure parts to the pressure parts.

5.12.4 Types of welds

5.12.4.1 Full penetration welds

A full penetration weld is one in which the components of the joint shall be completely fused together through the full depth of the joint and there shall be no unwelded lands.

The following welds shall be of the full penetration type:

- a) longitudinal and circumferential main seams in cylindrical shells, furnaces and reversal chamber wrapper plates, see Figure A.1;
- b) seams in flat end plates, see Figure A.1;
- c) unflanged flat end plates or tube plates where they are welded.
 - 1) to shells, see Figures A.13 a) and A.13 b);
 - 2) to furnaces, see Figure A.15;
 - 3) to reversal chamber wrapper plates, see Figures A.14 a) to A.14 c); and
 - 4) to access tubes, see Figure A.16 a) and A.16 b);
- d) attachment of flanged end plates, see Figure A.13 c);
- e) welds of branches, nozzles and pads greater than DN 80 considered to be reinforcing, see Figures A.4 to A.10;
- f) weld neck flanges to pipes, see Figure A.12;
- g) manhole frames, gusset stays, furnace stiffeners, and reversal chamber girder stay attachment welds.

5.12.4.2 Internal fillet welds (back welds)

When unflanged flat end plates or tube plates are welded to shells, furnaces and reversal chamber wrapper plates, the internal fillet welds shall be deposited for the full circumference of the seam, except as permitted for small boilers in accordance with EN 12593-3:2002, Table 10.2-3, water-walls of vertical boilers and electric boilers.

Other requirements for fillet welds shall be dictated by consideration of accessibility for welding. Notwithstanding these requirements, the fillet welds shall be inserted for the full circumference of the seam, whenever it is possible, to provide the requisite quality of the finished weld.

The profile of the fillet welds shall be such as to minimise harmful notch effects.

If sections of the fillet welds are omitted in accordance with EN 12953-3:2002, Table 10.2-3, special consideration shall be given to the welding technique to ensure sound root conditions, which shall be proved by procedure tests.

5.12.4.3 Other welds

Welds other than full penetration welds shall be permitted for welding stay tubes to tube plates, plain tubes to tube plates, bar stays to tube plates, and fillet welds attaching compensating plates.

5.12.5 Weld preparations

The dimensions and shape of the edges to be joined shall permit sound welds (see 5.12.1).

5.12.6 Welding plates of unequal thickness

If plate edges of unequal thickness are abutted, and if the difference between the surfaces on either side exceeds that specified in 5.15.9, the thicker plate shall be trimmed to a smooth taper $\leq 15^\circ$, including the width of the weld if so desired.

5.13 Openings in or adjacent to welds

Openings in or adjacent to welded seams shall be avoided, especially if the seams are not stress relieved. The minimum distance from the centreline of the welded seam to the nearest point of the weld of the connection, or edge of the opening, shall be 60 mm, or four times the shell plate thickness, whichever is the larger.

NOTE If this is not possible, it is recommended that the opening seam should cross the welded seam completely and so that the tangent at the point where the axis of the seam meets the edge of the opening is this axis as close as possible to 90° .

Crossing welded seams shall be non-destructively examined for a length of 60 mm, or four times the shell plate thickness, whichever is the larger, on each side of the opening.

5.14 Fillet Welds

Fillet welds may be employed as strength welds for pressure parts provided the limitations as given in annex A shall be observed. In order to ensure complete fusion at the root of the fillet welds, particular care shall be taken in the layout of joints with fillet welds.

5.15 Fabrication

5.15.1 General

The weld quality shall be in accordance with the requirements of this standard. The methods of welding main seams shall provide full penetration and it shall be demonstrated by welding procedure tests that the welding method can produce a weld that is free from defects.

The manufacturer shall include the preheating temperature in the welding procedure. The preheating temperature shall be determined by taking into consideration the composition and thickness of the metal being welded, the type of joint, the consumable being used and the heat input involved. General recommendations for preheating are contained in EN 1011-2, and no welding shall be carried out if the parent metal, within 150 mm of the joint, is at a temperature of less than 5°C .

5.15.2 Welding Processes

Any process shall be acceptable provided that it meets the requirements of the approved welding procedures (see 5.15.3.1).

5.15.3 Welding Approvals

5.15.3.1 Approval of fusion welding procedures

Fusion welding procedures shall be approved in accordance with EN 288-3 (see also 5.1.3).

The manufacturer shall specify all the welding processes to be approved prior to carrying out any welding procedure. The requirements and conditions for impact tests shall be as specified in the base material standard.

5.15.3.2 Approval of welders and welding operators

Welders shall be approved in accordance with EN 287-1.

Welding operators shall be approved in accordance with EN 1418 (see 5.1.3).

A copy of the welding procedure specification shall be available to the welder/operator.

5.15.4 Cutting, fitting and alignment

5.15.4.1 Plates shall be cut to size and shape by thermal cutting and/or machining.

NOTE For plates not thicker than 15 mm, cold shearing can be used provided that the edges are examined (visually or otherwise) and found suitable for welding.

5.15.4.2 Thermal cutting of plate, sections, bars and forgings shall be at an ambient temperature greater than 5 °C.

5.15.4.3 Plates shall be fitted, aligned and retained in position during welding.

Bars, jacks, clamps, tack welds, or other appropriate means shall be used to hold the edges to be welded in line. Tack welds shall be removed unless they are completely fused into the weld.

The edges of butt joints shall be held during welding so that the tolerances in 5.15.8 and 5.15.9 are not exceeded in the completed joint.

5.15.5 Longitudinal joints

Longitudinal seams in shells shall be welded from both sides, or from one side only if the welding procedure test gave acceptable results. If a backing strip is used, it shall be removed after welding and prior to any required non-destructive examinations, and shall be of a material that will not adversely influence the weld.

5.15.6 Circumferential joints

If circumferential seams in shells are welded from one side only with the use of a backing strip, this backing strip shall be removed after welding and prior to any required non-destructive examinations, and it shall be of a material that will not adversely influence the weld.

5.15.7 Surface condition before welding

The surface to be welded shall be clean and free from foreign material, such as grease, oil, lubricants and marking paints, for a distance of at least 25 mm from the welding edge. Detrimental oxide shall be removed from the weld contact area. If weld metal is to be deposited over a previously welded surface, all slag shall be removed to prevent inclusion in the weld metal.

5.15.8 Middle line alignments

For longitudinal joints, the middle lines of the plates shall be in accordance with Table 5.15-1 and Figure 5.15-1.

However, the limits for the alignments of the mid-lines may be exceeded if the design requires that the mid-lines be offset for some technical reasons, and these offsets shall be taken into account in the calculations.

Table 5.15-1 — Maximum misalignment for finished longitudinal joint in plates

Thinner plate thickness e mm	Maximum misalignment d_1 mm
$e \leq 10$	1
$10 < e \leq 40$	$e/10$
$40 < e$	4

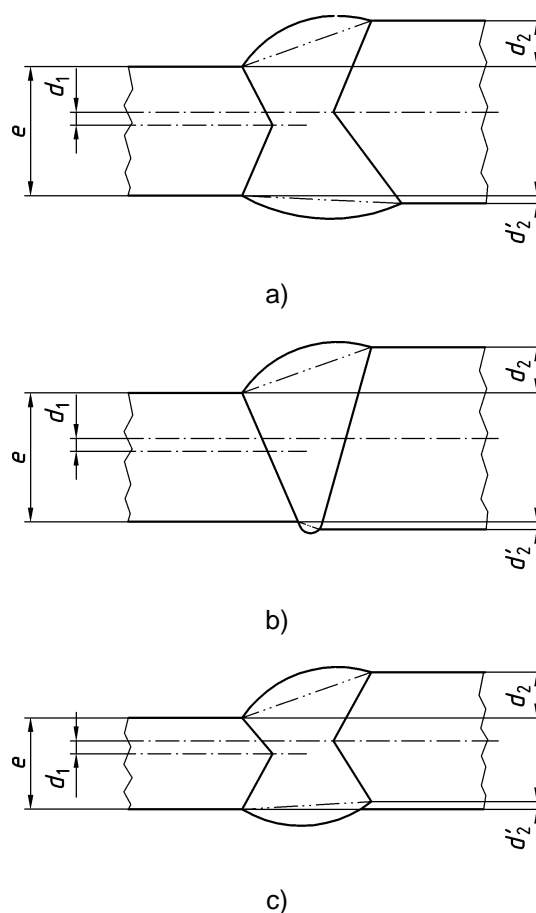


Figure 5.15-1 — Plate alignment

5.15.9 Surface alignment tolerances

5.15.9.1 Circumferential joints

The maximum misalignment at the surface of the plates (see Figure 5.15-1) shall be as given in Table 5.15-2. If this misalignment would otherwise be exceeded, the surface of the thicker plate shall be tapered $\leq 15^\circ$.

Table 5.15-2 — Maximum misalignment of plates with circumferential joints

Thinner plate thickness e mm	Maximum misalignment d_2 or d'_2 mm
$e \leq 20$	$e/4$
$20 < e \leq 40$	5
$40 < e$	$e/8$ but not greater than 20

5.15.9.2 Longitudinal joints

The maximum misalignment at the surface of the plates (see Figure 5.15-1) shall be as given in Table 5.15-3. If this misalignment would otherwise be exceeded, the surface of the thicker plate shall be tapered $\leq 15^\circ$.

Table 5.15-3 — Maximum misalignment of plates with longitudinal joints

Thinner plate thickness e mm	Maximum misalignment d_2 or d'_2 mm
$e \leq 12$	$e/4$
$12 < e \leq 48$	3
$48 < e$	$e/16$ but not greater than 6

5.15.10 Finished longitudinal and circumferential joints

To ensure that the weld grooves are completely filled so that the surface of the weld metal at any point does not fall below the surface of the adjoining plate, weld metal shall be built up as reinforcement on each side of the plate. This reinforcement shall not exceed the thicknesses given in EN 12953-5:2002, Table 5.5-2.

5.15.11 Fillet welds

The weld metal for load bearing fillet welds shall be deposited so that adequate penetration into the base metal at the root of the weld is secured, and sufficient weld metal shall be deposited to meet the calculated requirements.

5.15.12 Miscellaneous welding requirements**5.15.12.1 Double-sided welds**

The reverse side of double-sided welded joints shall be cleaned back to sound metal before applying weld metal from the reverse side.

NOTE This requirement is not intended to apply to any process of welding by which proper fusion and penetration are otherwise obtained and by which the base of the weld remains free from impurities.

5.15.12.2 Restart

If the welding is stopped for any reason, extra care shall be taken on restarting to obtain the required penetration and fusion.

NOTE For submerged arc welding, chipping out the groove in the crater is recommended.

5.15.12.3 Single-sided welds

Where single-sided welded joints are used, particular care shall be taken to ensure complete penetration and fusion at the bottom of the joint for its full length.

5.15.12.4 End plates welded prior to hot or cold forming

Hot forming of welded plates shall be permitted provided that the welded joint is subjected to 100 % volumetric examination after hot forming.

Cold forming of welded plates shall be allowed under the following conditions:

a) Forming precautions

Before cold forming, the weld reinforcement shall be ground smooth, and the manufacturer shall take precautions, where necessary, in order to avoid crack formation in the weld metal or the heat-affected zone;

b) Limiting thicknesses

The limiting thicknesses shall be 20 mm;

c) Forming

If the inside radius of curvature after forming is less than 10 times the thickness, an appropriate post forming heat treatment shall be applied;

d) Control

After cold forming, the welded joints shall be visually examined and subjected to 100 % volumetric examination throughout their length. Joints of any thickness which have been cold formed to an inside radius less than that specified in c) shall be inspected for cracks by magnetic particle or penetrant methods or by other agreed methods.

5.15.12.5 Attachments

5.15.12.5.1 Lugs, brackets, stiffeners, and other attachments shall fit to the curvature of the shell or other surface to which they are to be attached.

5.15.12.5.2 Temporary attachments welded to the pressure parts shall be kept to a practical minimum.

5.15.12.5.3 Temporary attachments shall be removed prior to the first pressure test unless they have been designed to the same standard as permanent attachments.

5.15.12.6 Removal of attachments

5.15.12.6.1 Where construction attachments are to be removed, the technique used shall be such as to avoid impairing the pressure part proper.

5.15.12.6.2 The areas from which temporary attachments have been removed shall be dressed smooth and be examined by an appropriate non-destructive examination.

5.15.13 Repair of weld defects

Any repair to a weld shall be recorded.

The manufacturer, after due consideration of the importance and number of defects to be removed shall decide whether to carry out a number of local repairs, or whether to produce a new complete joint after grinding of the weld concerned.

The welding procedures for local or complete repairs shall be approved. If the defects being repaired do not require the use of a welding procedure different from that already approved, and if the manufacturer decides to use this procedure for the above mentioned repair, no approval test shall be necessary.

In the case of recurring unacceptable imperfections, the cause shall be determined and corrective action taken, all of which shall be recorded.

5.16 Post-weld heat treatment and other heat treatments

5.16.1 General

Post-weld heat treatment shall be carried out where the wall thickness at any welded connection exceeds 35 mm.

NOTE It is permissible to increase the limiting thickness to 40 mm where the impact property of the material is at least 50 J.

The heat treatment shall be carried out prior to the proof test.

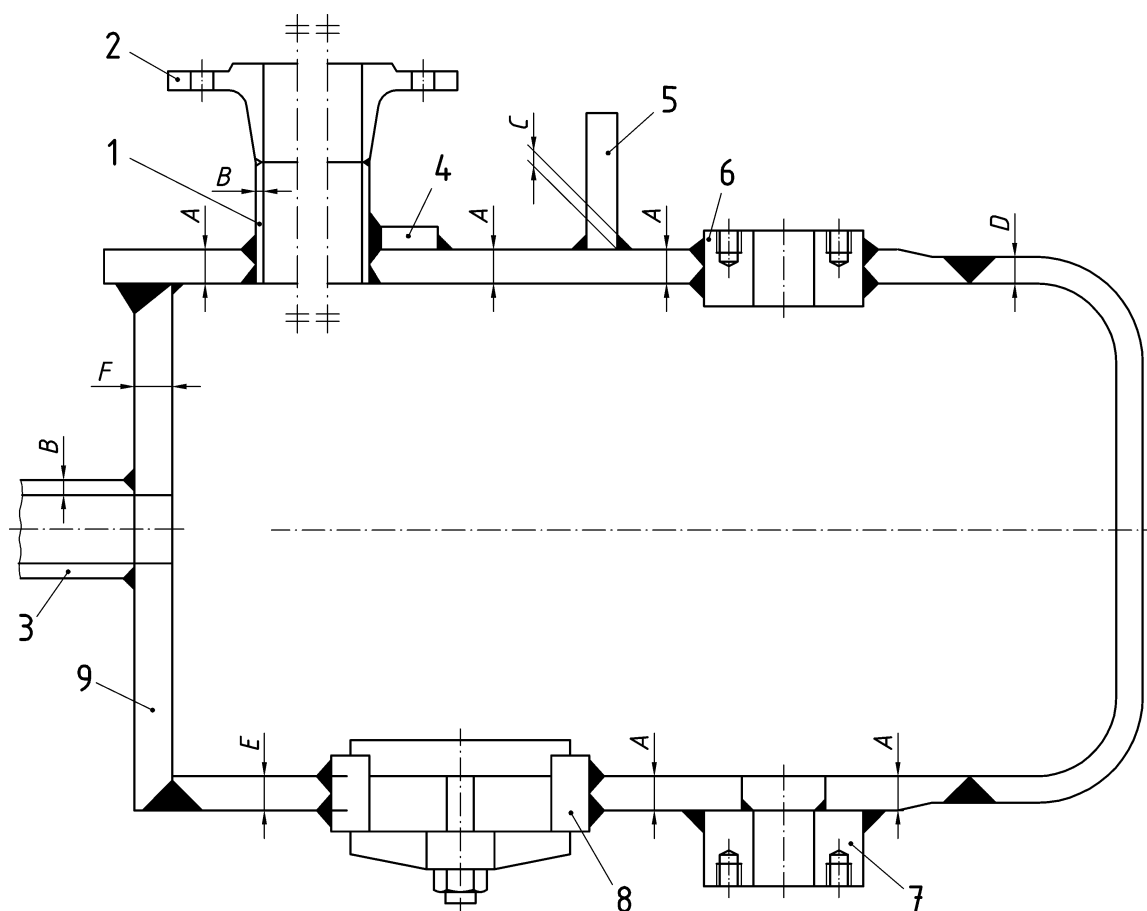
If certain items e. g. nozzles, are added after the final heat treatment, local heat treatment shall be permitted.

When welded repairs have been made to a boiler which has already been heat treated, the requirements for the boiler to be heat treated again shall be considered.

5.16.2 Material thickness

If a welded joint connects parts of different thickness, the thicknesses to be considered in applying the limits given in 5.16.1 shall be the following nominal thicknesses, including corrosion allowance (see Figure 5.16-1):

- a) the thickness of the shell or flat plate, as appropriate, in nozzle or pad attachment welds **(A)**;
- b) the thickness of the nozzle neck at the nozzle neck to flange welds, and set-on nozzle to shell or flat plate welds **(B)**;
- c) the throat thickness of the weld at the point of attachment where a non-pressure part is welded to a pressure part **(C)**;
- d) the thinner of two adjacent butt-welded plates, including dished end to shell connections **(D)**;
- e) the thickness of the shell in connections to flat plates which are butt welded to the shell **(E)**;
- f) the thickness of flat plates where they are set into the shell **(F)**.



Key

- | | |
|---------------------|-----------------|
| 1 Nozzle (set in) | 6 Pad (set in) |
| 2 Flange | 7 Pad (set on) |
| 3 Nozzle (set on) | 8 Manhole frame |
| 4 Reinforcing plate | 9 Flat plate |
| 5 Non-pressure part | |

Figure 5.16.1 — Thickness to be considered when determining the requirement for post weld heat treatment

5.16.3 Post-weld heat treatment temperatures

5.16.3.1 Plain carbon manganese steels shall be heated for stress-relief purposes within the range of 550 °C to 600 °C. The holding time within this temperature range shall be 2 min/mm thickness, with a minimum of 30 min and a maximum of 120 min.

The temperature of the furnace at the time the boiler is placed in it shall not exceed 300 °C.

5.16.3.2 The rate of heating above 300 °C shall not exceed

$$\frac{5\ 500}{e} \text{ °C/h or } 55 \text{ °C/h whichever is the greater,}$$

where

e is the plate thickness, in mm.

5.16.3.3 During the heating period, the temperature variation between points 4,5 m apart shall not exceed 150 °C, and when at the holding temperature, the temperature throughout the portion of the boiler being heated shall be within the range specified in 5.16.3.1.

5.16.3.4 During the heating and holding periods, the furnace atmosphere shall be so controlled as to avoid excessive oxidation of the surface of the boiler. There shall be no direct impingement of the flame on the boiler.

5.16.3.5 The boiler shall be cooled in the furnace to 300 °C at a rate not exceeding

$$\frac{5\ 500}{e} \text{ °C/h or } 55 \text{ °C/h whichever is the greater,}$$

where

e is the plate thickness, in mm.

NOTE Below 300 °C, the boiler can be cooled in still air.

5.16.3.6 The temperature specified shall be the actual temperatures of any part or zone of the boiler being heat treated and shall be measured at the outside surface by thermocouples in effective contact with the boiler and located in areas local to the joints requiring stress relief (see 5.16.2).

5.16.3.7 A sufficient number of temperatures shall be recorded continuously and automatically. Thermocouples shall be applied to ensure that the whole boiler, or part of the boiler being heat treated, is within the range specified.

5.16.4 Other heat treatments

If a normalizing heat treatment is carried out, the part to be normalized shall be brought up to the required temperature slowly, as indicated in the European Standards for material, and held at that temperature for a period sufficient to soak the part thoroughly. If the geometry of the part causes insufficiently homogeneous cooling, a stress-relieving heat treatment shall be applied after the normalising treatment.

5.16.5 Heat treatment of test plates

If a welded production test plate is required, it shall be placed inside the pressure part it represents during heat treatment, or, if this is impracticable, the test plate shall be placed alongside the pressure part it represents in such a position in the furnace that it will receive similar heat treatment.

NOTE The test plate can be heated separately from the pressure part, provided that the following factors are the same for the test plate and the pressure part:

- a) rate of heating, maximum temperature;
- b) time held at temperature;
- c) condition of cooling.

The heat treatment temperatures of separately heated test plates shall be recorded.

Annex A (informative)

Typical examples of acceptable weld details

A.1 General

The figures given in this annex are recommendations with regard to connections welded by the metal-arc process in shell boilers. The following types of connections are covered:

	Figures
Plate preparation for butt-welded longitudinal and circumferential seams	A.1
Standard weld preparation details for branches	A.2
Weld preparation details for set-in branches	A.3
Set-on branches	A.4
Set-in branches	
a) With symmetrical welds	A.5
b) With asymmetric welds	A.6
c) Welded from one side only	A.7
Branches with added compensation rings	
a) Set-on branches	A.8
b) Set-in branches	A.9
Studded connections	A.10
Flanges	A.11 and A.12
End plates or tube plates to shell	A.13
End plates or tube plates to reversal chamber wrapper plates	A.14
Furnaces to tube plate or end plates	A.15
Access tube to end plate	A.16

A.2 Purpose

The purpose of this annex is to exemplify sound and commonly accepted practice and not to promote the standardization of connections that may be regarded as mandatory, or to restrict development in any way. A number of connections have been excluded that, whilst perfectly sound, are restricted in their use to certain applications, manufacturers, or localities. Furthermore, the future desirability of introducing amendments and additions to reflect improvements in welding procedures and techniques as they develop is appreciated.

A.3 Selection of detail

The connections recommended are not, of course, considered to be equally suitable for all service conditions, nor is the order in which they are shown indicative of their relative mechanical characteristics. In selecting the appropriate detail to use from the several alternatives given for each type of connection, consideration should be given to the manufacture and service conditions.

A.4 Weld profiles and size

A.4.1 Weld profiles

The limitations quoted in weld profiles and sizes are based on commonly accepted sound practice, but they can be subject to modifications dictated by special welding techniques or design conditions.

Recommended weld profiles (e.g. bevel angles, root radii, and root faces) are indicated by a letter and number in a circle, that refer to the profiles shown in Figure A.2. They are designed to provide correct conditions for welding and to facilitate the deposition of sound weld metal in the root of the joint. This is particularly important in the case of single-bevel and single-J welds.

A.4.2 Butt joints

If butt joints are indicated, it is intended that they should be back chipped or gouged and back welded, or alternatively that the welding procedure should be such as to ensure sound positive root penetration.

A.4.3 Weld sizes

The sizes of the welds, i.e. throat thicknesses, are proportioned to develop the full strength of the joined parts.

A.4.4 Modifications

Cases can well arise where sound modifications can be made with advantage

- a) to the weld profiles to suit special welding techniques, or
- b) to the weld sizes to suit design and service conditions.

A.5 Types of connections (see Figures A.4 to A.16)

A.5.1 The dimensions and shape of the detail chosen can influence the feasibility and/or efficiency of ultrasonic examination. This can also be a function of the equipment and time available. If ultrasonic examination is specified, these factors should be considered.

A.5.2 If welds are made from one side only, the penetration bead should have a smooth contour and should be flat or slightly convex.

A.5.3 The use of ring-type compensation is not suitable for cases with severe temperature gradients.

A.5.4 If partial penetration joints are used, root defects can be present and these cannot always be detected or interpreted by means of non-destructive examination. The use of partial penetration joints is not suitable for cases where there are severe fluctuating temperature gradients..

A.5.5 In addition to the necessity for care in selecting weld details for tube to tube plate connections, special attention should be given to the choice of the welding and inspection techniques used.

A.5.6 If the root spigot is not produced by forging, it should be insured that the through thickness properties are adequate for the design.

A.5.7 If ultrasonic inspection is required, it can be necessary to examine the welded connection between the branch and shell prior to fitting the compensation ring.

A.6 Branches (see Figures A.4 to A.10)

Weld sizes are proportioned to develop the full strength of the parts joined (see also A.4.3 and A.4.4, as well as A.7.2.1).

A.7 Branches without compensation rings (see Figures A.4 to A.7)

A.7.1 Set-on branches

Consideration should be given to the necessity for examining the shell plate for laminations around the branch hole when set-on branches are used.

A.7.2 Set-in branches

A.7.2.1 General

Consideration should be given to the necessity for examining the shell plate for laminations around the branch hole when set-in branches are used.

A.7.2.2 Weld sizes

The type of branch to shell connections and the sizes of welds employed can be influenced by several factors in the operational conditions for which the boiler is designed. For general guidance in this annex, weld sizes have been shown for the various connections recommended, based on the concept that the welded joints should develop the full strength in tension of the branch radial to the shell as indicated in Figures A.3 a) and A.3 b). In general, it should therefore be unnecessary to apply larger welds than those shown.

The simple, though approximate, assumption has been taken that the total throat thickness of the welds should equal twice the branch thickness. It has also been assumed that the welds should be reasonably symmetrical about the full thickness of the connection.

It is further recommended that, if the branch thickness exceeds half the thickness of the shell, full penetration joints should be used with fillet welds equal in total throat thickness to 20 % of the shell thickness, as shown in Figures A.3 c) and A.3 d). This additional throat thickness is recommended to compensate for the relative practical difficulty of applying perfectly sound welds in nozzle connections and of applying non-destructive tests for their examination. These additional fillet welds are also intended to provide a reasonable geometric profile. For practical reasons, a minimum dimension of 6 mm has been applied to the fillet weld size.

There may be service conditions for which smaller welds are adequate, and a competent engineer can reduce the weld sizes.

A.7.2.3 Gap between branch and shell

It is recommended that the gap between the branch and the shell should not exceed 3 mm. Wider gaps increase the tendency for spontaneous cracking during welding, particularly as the thickness of the parts joined increases.

A.7.2.4 Removal of internal sharp edge in branch bore

It will be noted that the internal edges in the bores of set-in branches are shown radiused because a stress concentration occurs at this point. This precaution is recommended when the branch connection is fully stressed or subjected to fatigue, but cannot be necessary where these conditions do not obtain.

A.7.2.5 Preparation of hole in shell

For set-in branches of the types shown in Figures A.5 to A.7, the hole in the shell can be cut and profiled in two ways as follows.

- a) The depth of the grooves B and D can be constant around the hole (see Figure A.3 e). This, the normal case, is the concept upon which the drawings have been prepared (see, for example, Figure A.6);
- b) The roots of the weld grooves can be in one plane, as, for example, when they are machine bored, in which case the depths of the grooves can vary around the hole (see Figure A.3 f).

A.8 Branches with added compensation rings (see Figures A.8 and A.9)

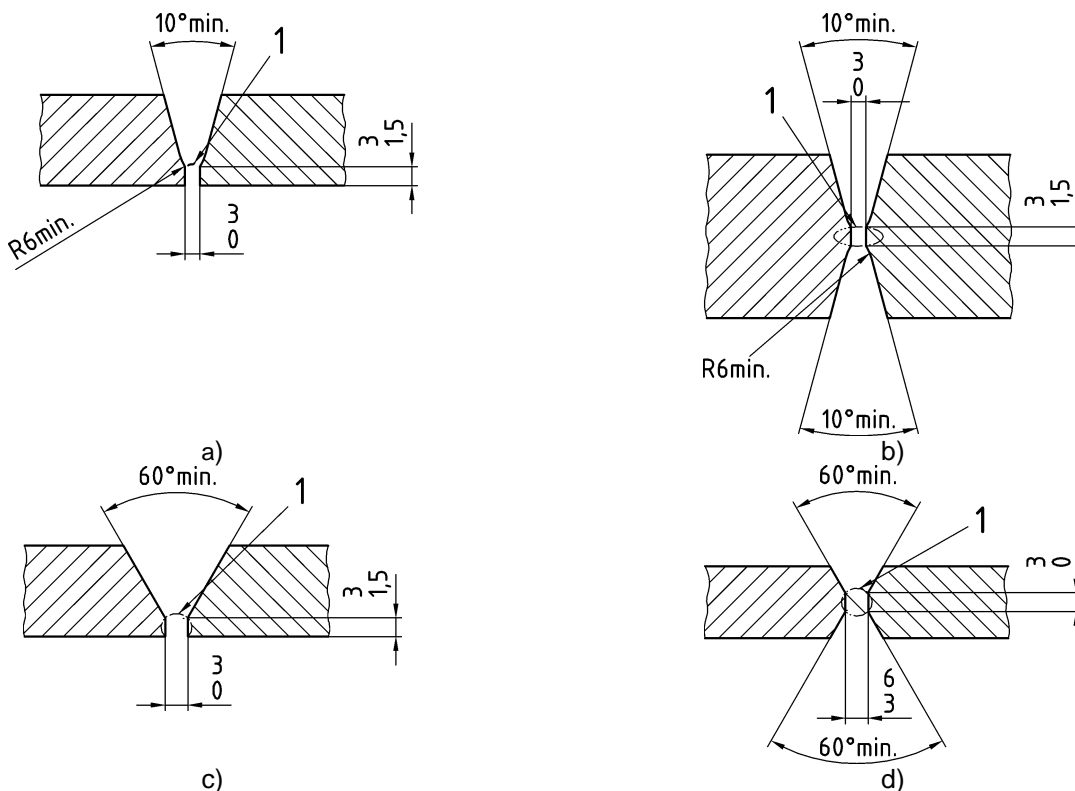
A.8.1 General

Compensation rings should be a close fit to the shell and tell-tale holes should be provided in them.

A.8.2 Set-in branches

It is recommended that the gap between the branch and the shell should not exceed 3 mm. Wider gaps increase the tendency to spontaneous cracking during welding, particularly as the thickness of the parts joined increases.

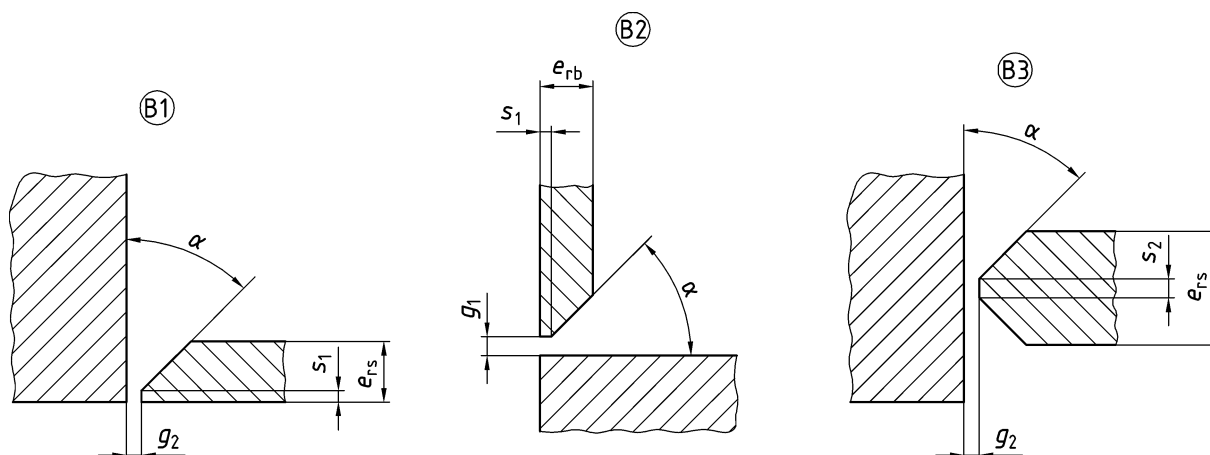
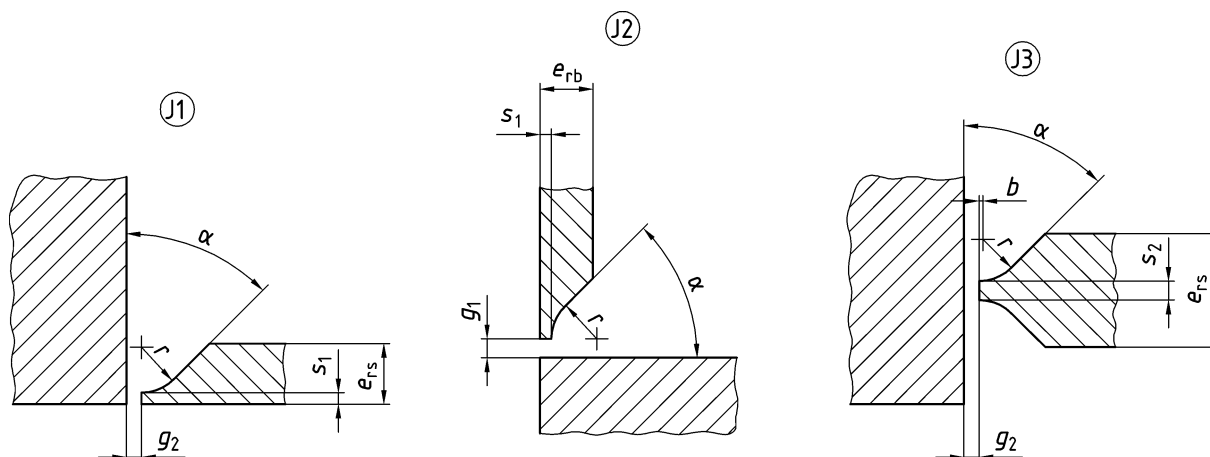
Dimensions in millimetres



Key
 1 Gouge out before applying weld from the second side

Figure A.1 — Plate preparation for butt-welded longitudinal and circumferential seams

Dimensions in millimetres

**Key** $\alpha = 45^\circ \text{ min}$ $s_1 = 1,5 \text{ to } 2,5$ $g_1 = \{1,5 \text{ to } 2,5 \text{ when } e_{rb} < 9,5; 2,5 \text{ to } 4 \text{ when } e_{rb} \geq 9,5\}$ $s_2 = 0 \text{ to } 3$ g_2 see NOTE 2**Key** $\alpha = 15^\circ \text{ to } 35^\circ$ $s_1 = 2 \text{ to } 3$ $s_2 = 2 \text{ to } 3$ $g_1 = 1,5 \text{ to } 2,5$ g_2 see note 2 $b = 0 \text{ to } 3$ $r = 6 \text{ to } 13$

NOTE 1 Discretion should be used in applying the maximum and minimum dimensions quoted which are subject to variation according to the welding procedure employed (for example, size and type of electrodes) and also to the position in which the welding is carried out.

NOTE 2 The gap between the branch and shell should not exceed 3 mm. Wider gaps increase the tendency to spontaneous cracking during welding, particularly as the thickness of the parts joined increases.

Figure A.2 — Standard weld preparation details for branches

Dimensions in millimetres

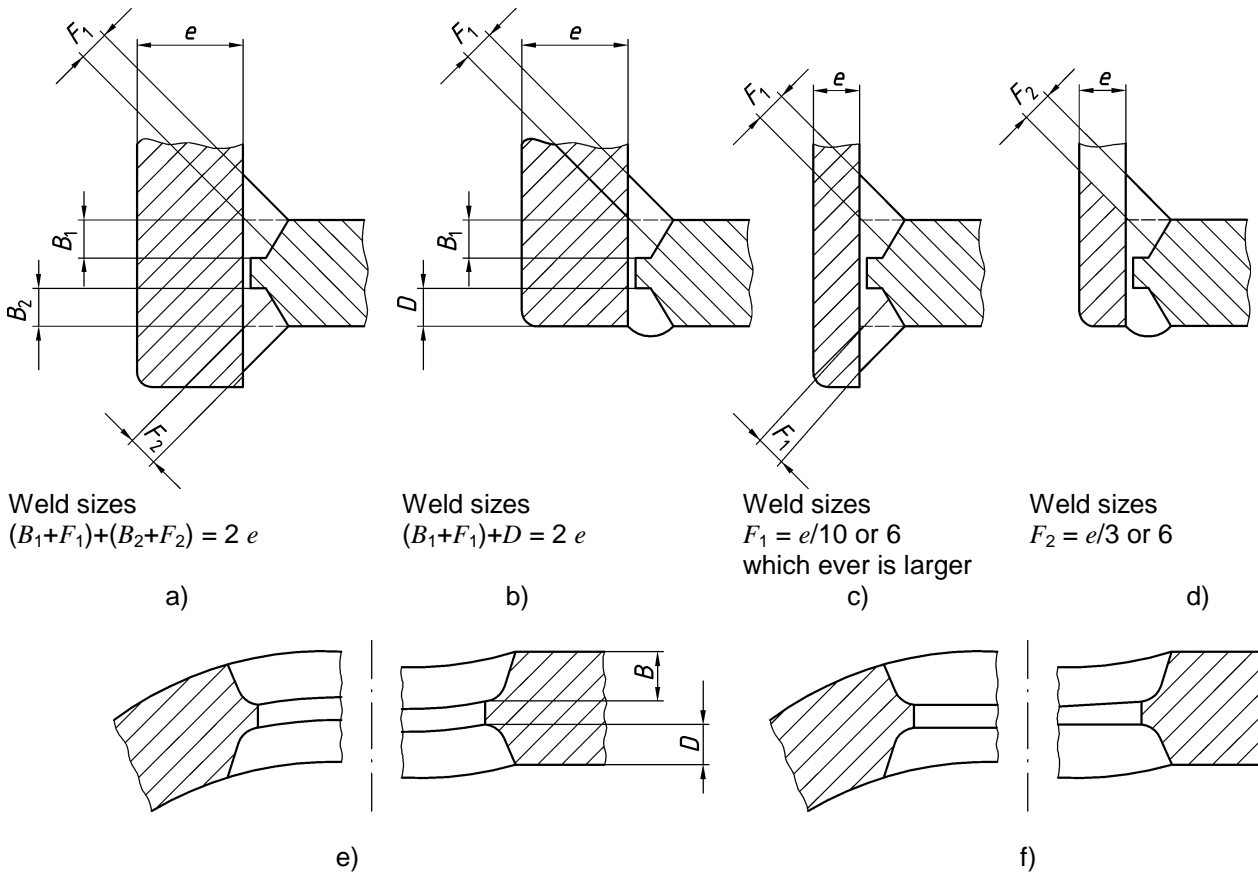
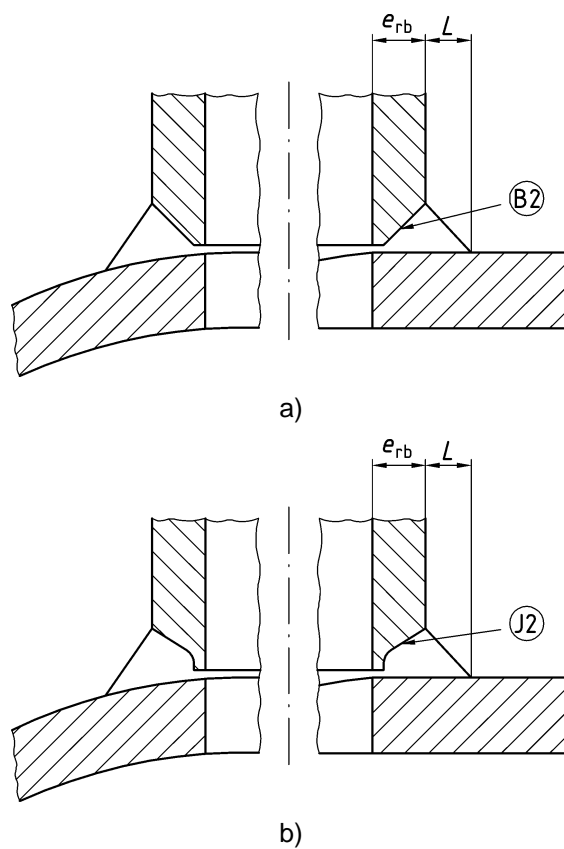


Figure A.3 — Typical weld preparation details for set-in branches

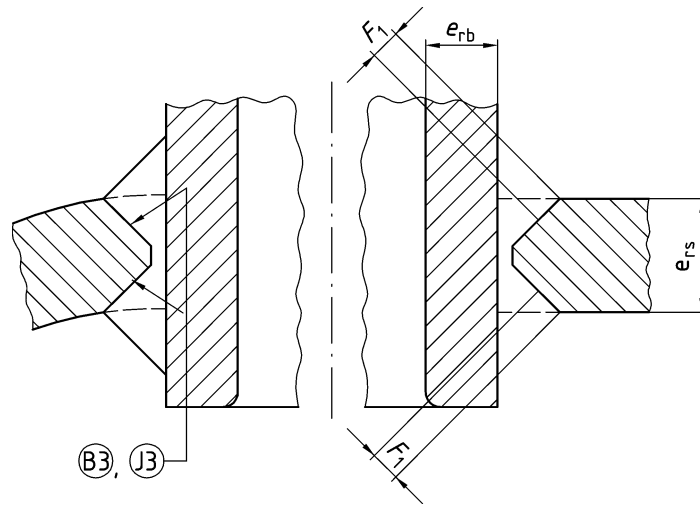
Dimensions in millimetres



NOTE 1 For details B2 and J2, see Figure A.2

NOTE 2 $L = e_{rb}/3$ min, but not less than 6

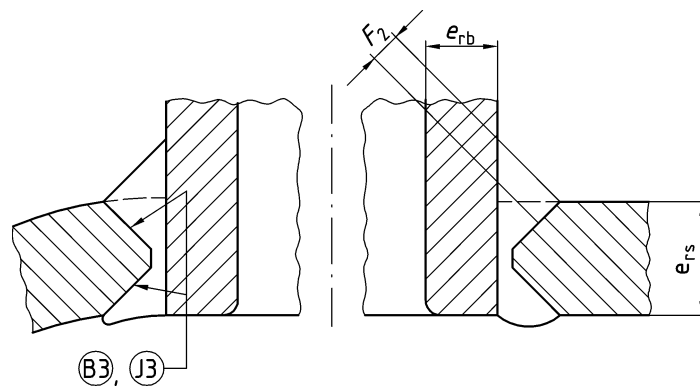
Figure A.4 — Typical weld preparation details for set-on branches



Key

$F_1 = e_{rs}/10$ min, or 6, whichever is larger

a)



Key

$F_2 = e_{rs}/5$ min, or 6, whichever is larger

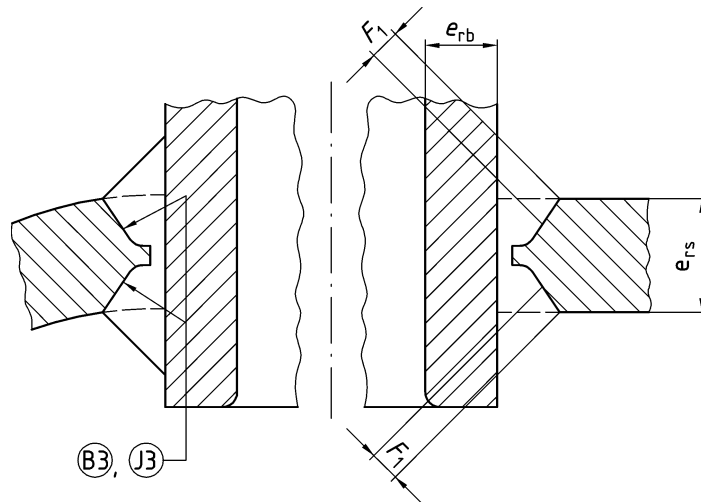
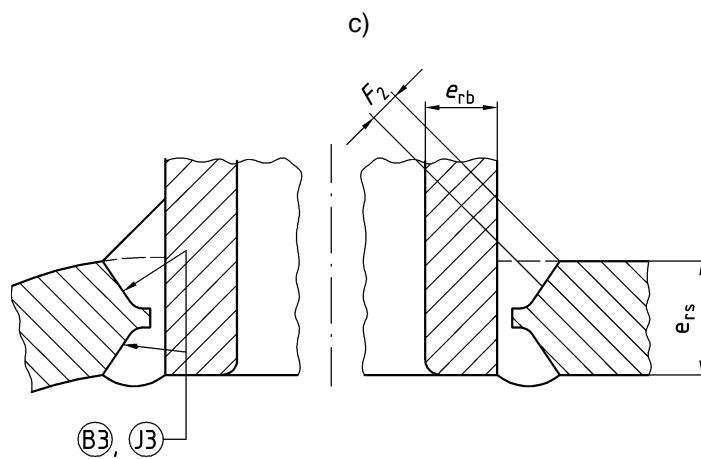
b)

NOTE 1 Full penetration connections. Generally used when e_{rb} is greater than $e_{rs}/2$.

NOTE 2 For detail B3 and J3, see Figure A-.

Figure A.5 — Typical weld preparation details for set-in branches

Dimensions in millimetres

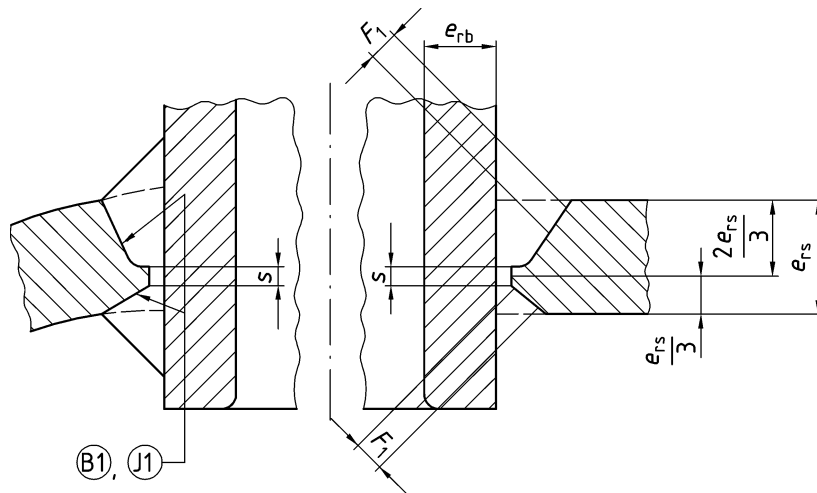
**Key**
 $F_1 = e_{rs}/10 \text{ min, or } 6, \text{ whichever is larger}$
**Key**
 $F_2 = e_{rs}/5 \text{ min, or } 6, \text{ whichever is larger}$

d)

NOTE 1 Full penetration connections. Generally used when e_{rb} is greater than $e_{rs}/2$.

NOTE 2 For detail B3 and J3, see Figure A.2

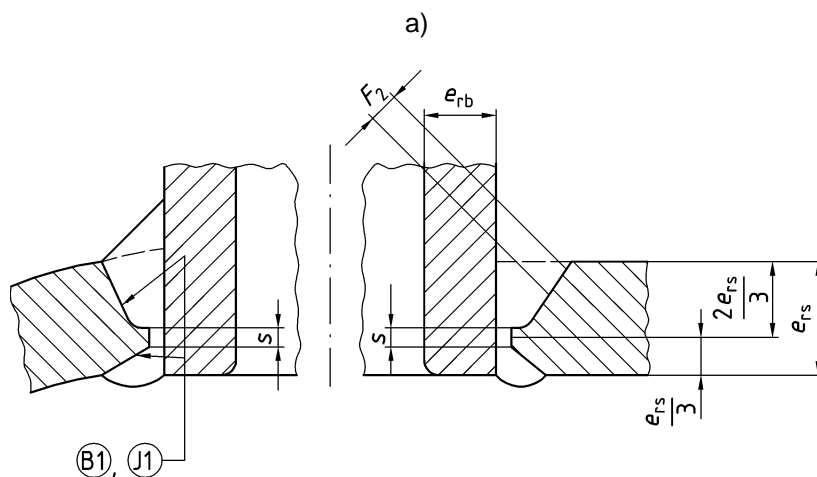
Figure A.5 — Typical weld preparation details for set-in branches (concluded)



Key

$s = 1,5$ to $2,5$

$F_1 = e_{rs}/10$ min, or 6, whichever is larger



Key

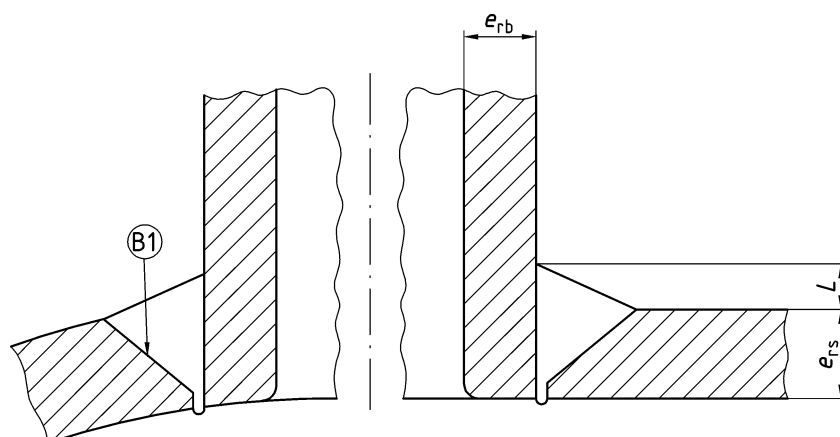
$s = 1,5$ or $2,5$

$F_2 = e_{rs}/5$ min, or 6, whichever is larger

NOTE For details B1 and J1, see Figure A.2

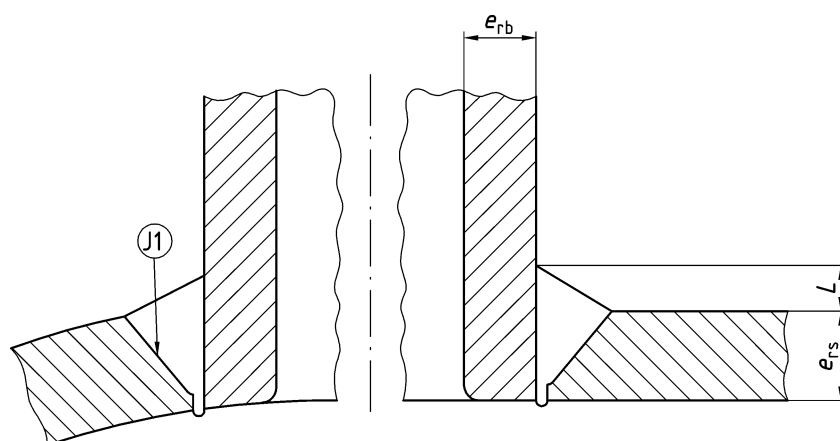
Figure A.6 — Typical weld preparation details for set-in branches with asymmetric welds

Dimensions in millimetres

**Key**

$L = e_{rb}/3$ min, but not less than 6

a)

**Key**

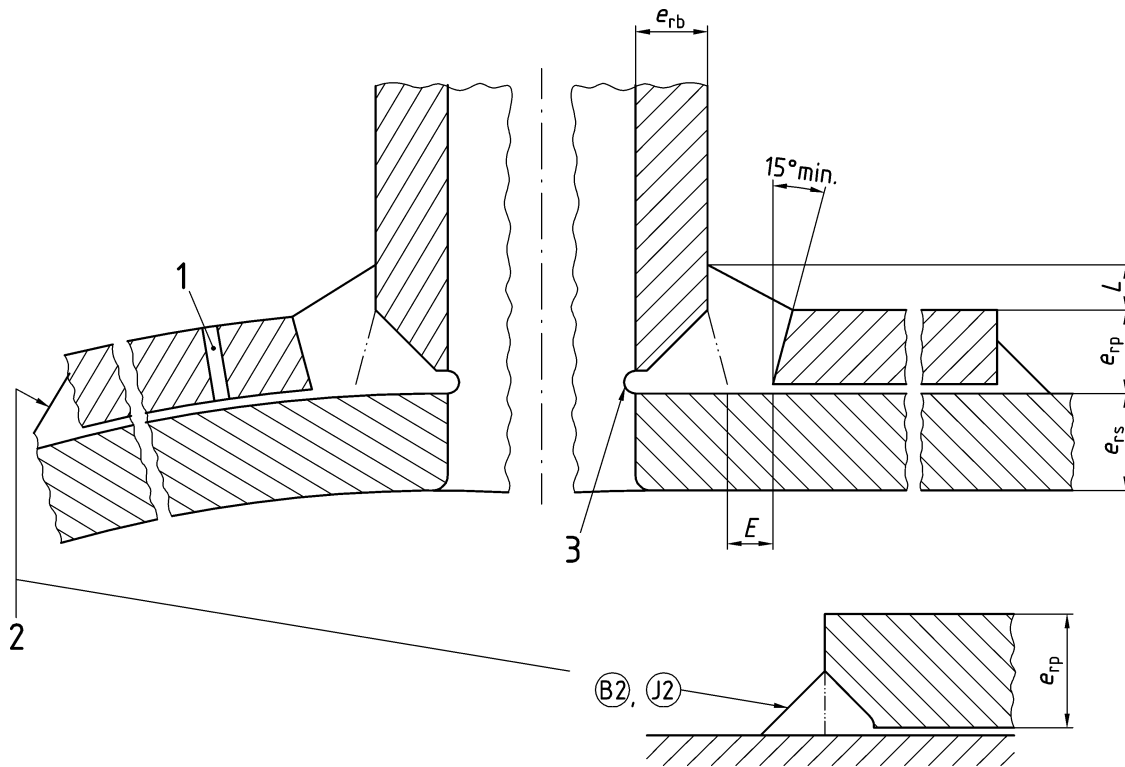
$L = e_{rb}/3$ min, but not less than 6

b)

NOTE 1 For details B1 and J1, see Figure A.2.

NOTE 2 Set-in branches should also be welded on the inside of the shell (see Figures A.5 and A.6) if they are accessible for this purpose, otherwise preference should be given to set-on branch connections (see Figure A.4). However, the connections (see Figures A.7 a) and A.7 b)) are considered to be acceptable, but only if assurance can be provided that the welding procedure employed will ensure sound and consistent root conditions with uniform penetration.

Figure A.7 — Typical weld preparation details for set-in branches welded from one side only



Key

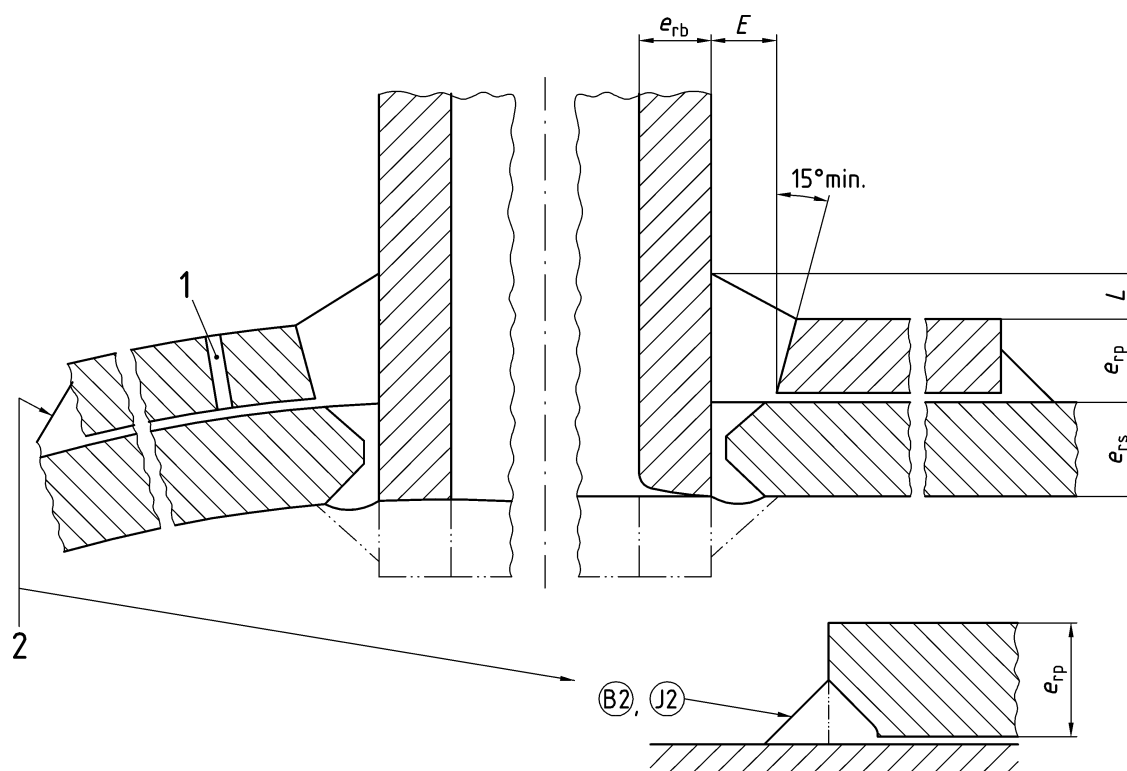
- 1 Tell-tale hole
- 2 Consideration can be given to this detail as the required weld size is increased
- 3 For shell-to-branch connection, see Figure A.4

NOTE 1 Where $E \geq 6$ min and $L = e_{rb}/3$ min, but not less than 6

NOTE 2 For details B2 and J2, see Figure A.2.

Figure A.8 — Typical weld preparation details for set-on branches with added compensation rings

Dimensions in millimetres

**Key**

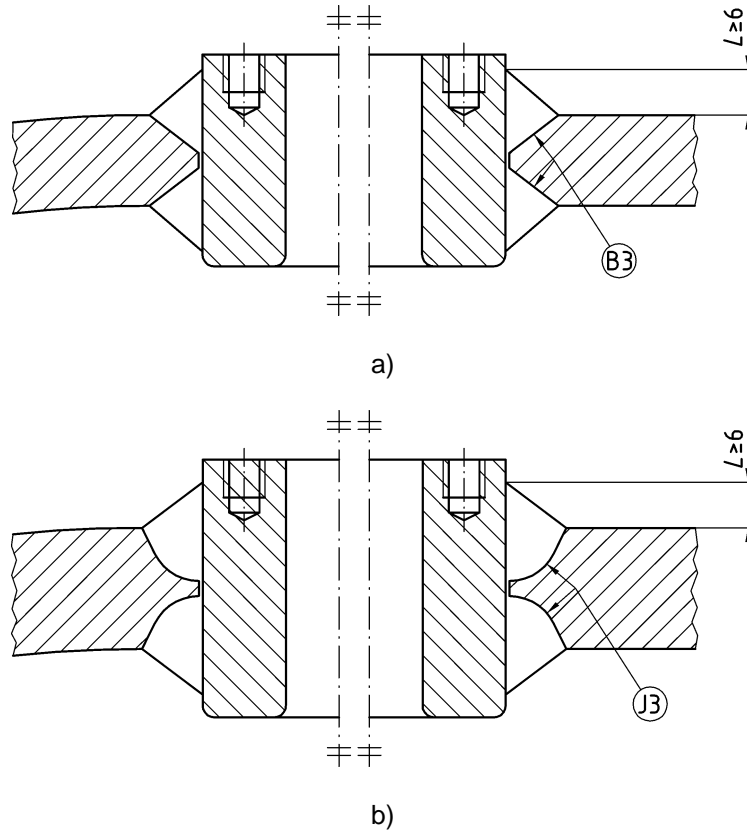
- 1 Tell-tale hole
 2 Consideration can be given to this detail as the required weld size is increased

NOTE 1 Where $E \geq 6$ min and $L = e_{rb}/3$ min, but not less than 6

NOTE 2 For details B2 and J2, see Figure A.2.

Figure A.9 — Typical weld preparation details for set-in branches with added compensation rings

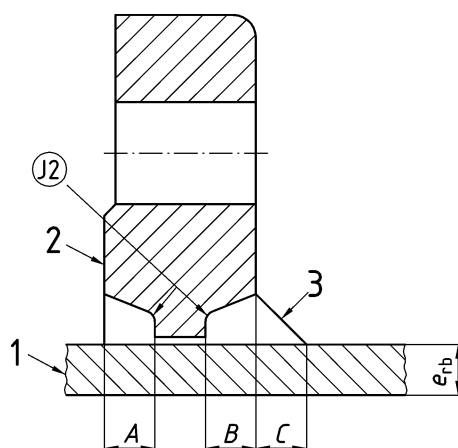
Dimensions in millimetres



NOTE For details B3, J3 and B2, see Figure A.2.

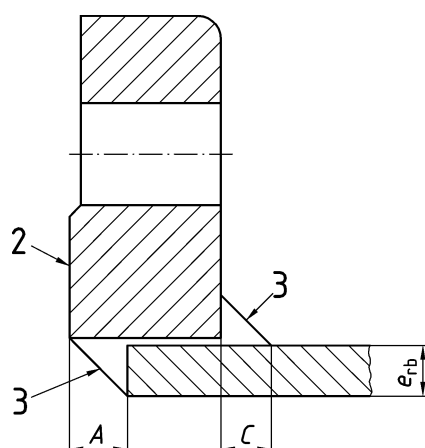
Figure A.10 — Typical weld preparation details for studed pads

Dimensions in millimetres

**Key**

$A = e_{fb}$ min, after machining flange to final thickness $B = e_{fb}$ $C = e_{fb}$

a) Face and back welded flange

**Key**

$A = e_{fb}$ min, after machining flange to final thickness $C = e_{fb}$

1 To project when assembled for welding

2 Generally machined after welding

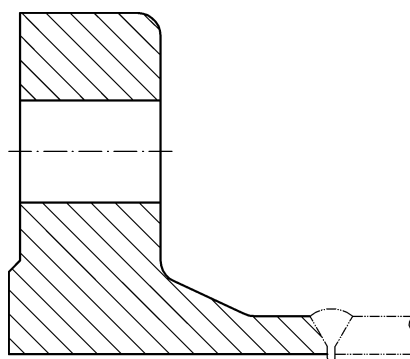
3 See A.5.4

b) Fillet welded flange

NOTE 1 The clearance between the bore of the flange and the outside diameter of the vessel should not exceed 3 mm at any point and the sum of the clearances diametrically opposite should not exceed 5 mm.

NOTE 2 For detail J2, see Figure A.2.

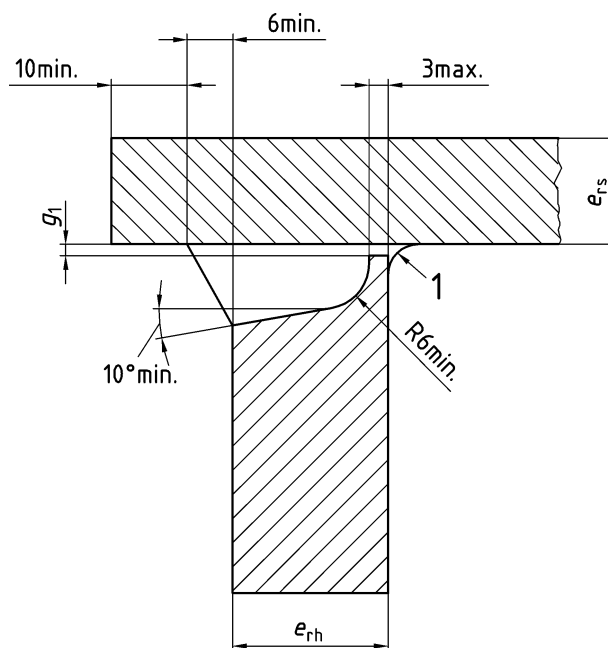
Figure A.11 — Typical weld preparation details for flanges



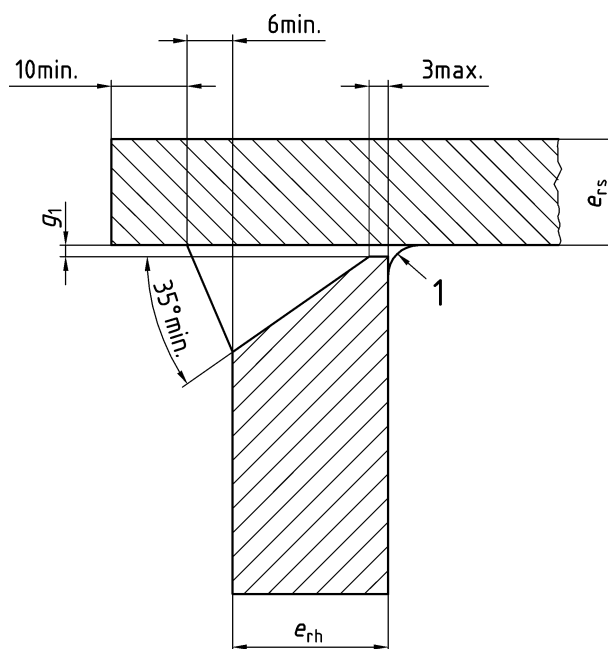
NOTE See A.5.2.

Figure A.12 — Typical weld preparation details for weld-neck flange

Dimensions in millimetres



a) Construction for set-in end plates



b) Alternative construction for set-in end plates

Key

- 1 The shape of the internal fillet weld should be concave, and the minimum throat thickness should be related to the shell thickness as follows:

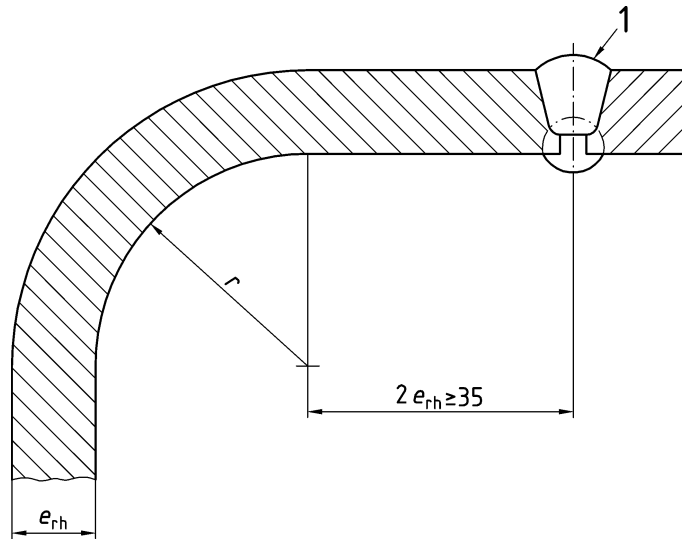
Shell thickness, e_{rs}	Minimum throat thickness
$e_{rs} < 12$	4
$12 \leq e_{rs} \leq 16$	5
$16 < e_{rs}$	6

$g_1 = 1,5$ to 3

The internal fillet welds can be omitted (see 5.12.4.2)

Figure A.13 — Typical weld preparation details for attachment of end plates or tube plates to shell

Dimensions in millimetres



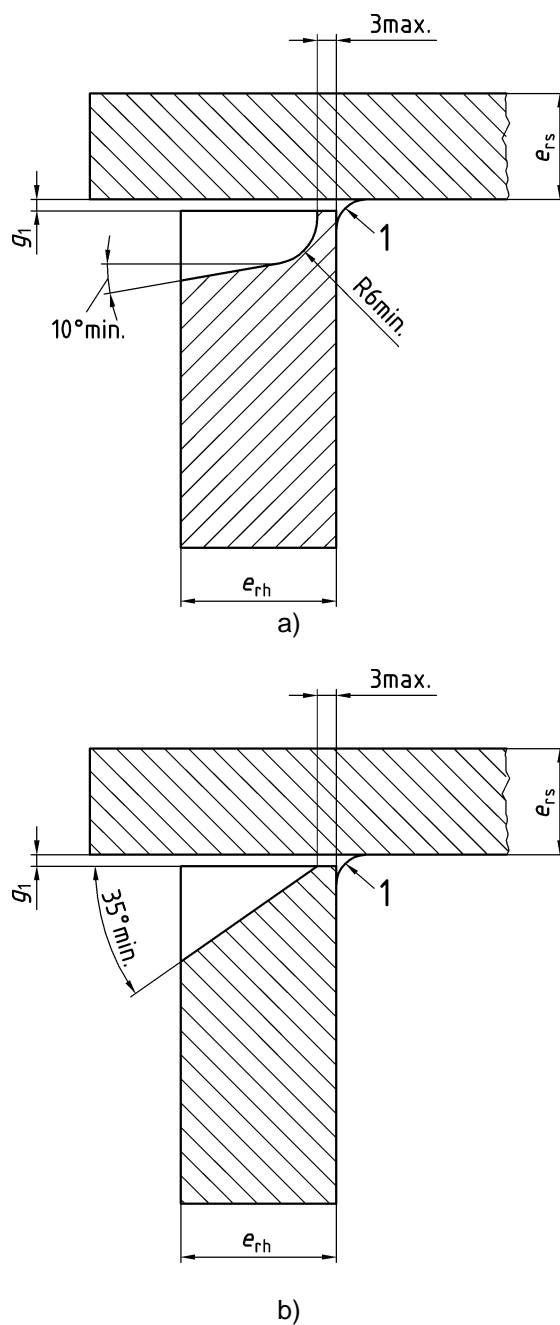
Key

1 See Figure A.1

c) Construction for flanges end plates

Figure A.13 — Typical weld preparation details for attachment of end plates or tube plates to shell
(concluded)

Dimensions in millimetres

**Key**

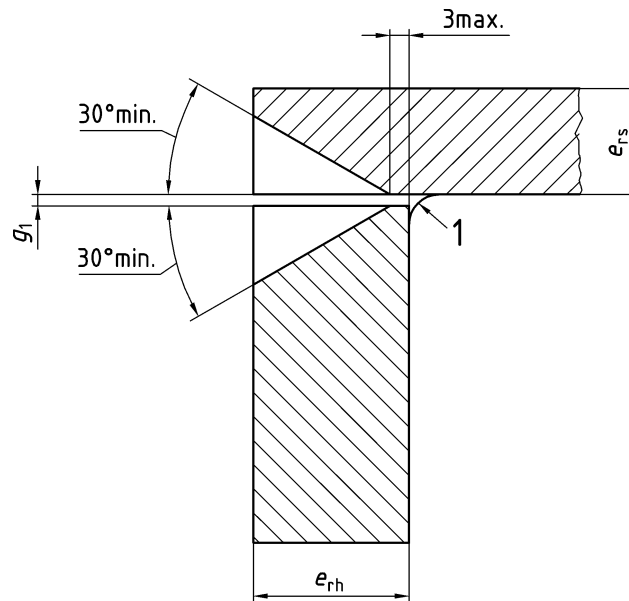
- 1 The shape of the internal fillet weld should be concave, and the minimum throat thickness should be related to the shell thickness as follows:

Shell thickness, e_{rs}	Minimum throat thickness
$e_{rs} < 12$	4
$12 \leq e_{rs} \leq 16$	5
$16 < e_{rs}$	6

$g_1 = 1,5$ to 3

Figure A.14 — Typical weld preparation details for attachment of end plates or tube plates to reversal chamber wrapper plates

Dimensions in millimetres



c)

Key

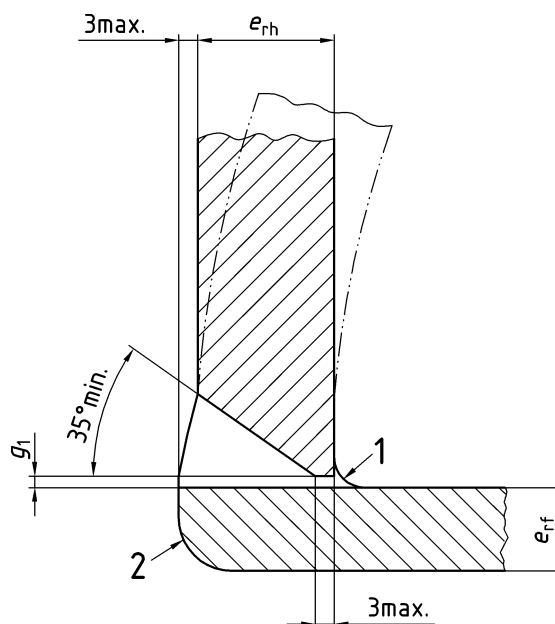
1 The shape of the internal fillet weld should be concave, and the minimum throat thickness should be related to the shell thickness as follows:

Shell thickness, e_{rs}	Minimum throat thickness
$e_{rs} < 12$	4
$12 \leq e_{rs} \leq 16$	5
$16 < e_{rs}$	6

$g_1 = 1,5$ to 3

Figure A.14 — Typical weld preparation details for attachment of end plates or tube plates to reversal chamber wrapper plates (concluded)

Dimensions in millimetres

**Key**

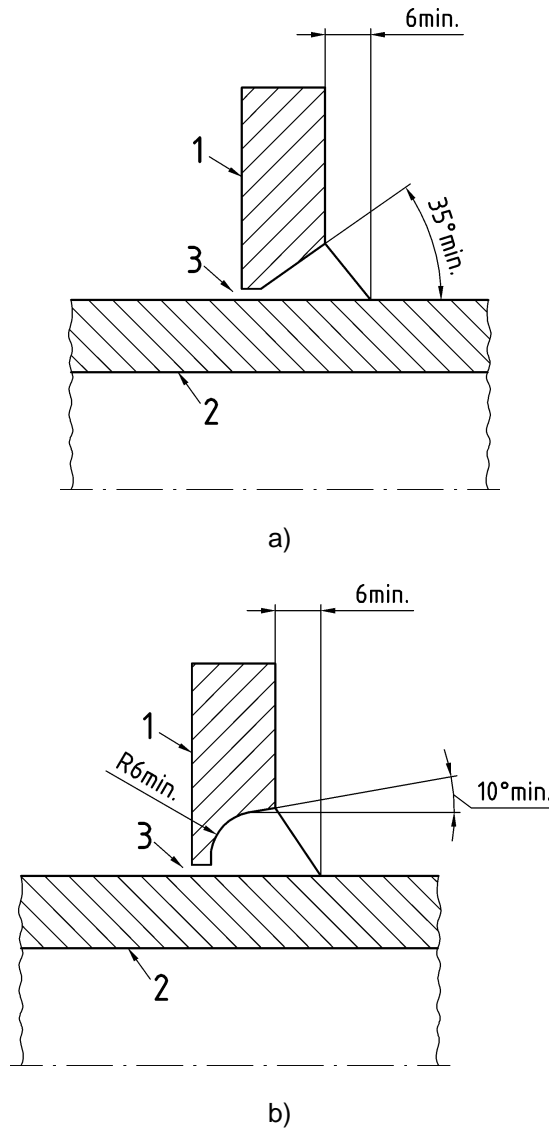
- 1 The shape of the internal fillet weld should be concave, and the minimum throat thickness should be related to the shell thickness as follows:

Furnace thickness, e_{rs}	Minimum throat thickness
$e_{rs} < 12$	4
$12 \leq e_{rs} \leq 16$	5
$16 < e_{rs}$	6

- 2 The plate edge radius of not less than $e_{tf}/2$ is only required when the furnace end is exposed to flame or comparably high temperature.

$g_1 = 1,5$ to 3

Figure A.15 — Typical weld preparation details for attachment of furnaces to tube plates or end plates



Key

- 1 End plate
- 2 Access tube
- 3 The nose thickness and gap should be such as to ensure full penetration is achieved

Figure A.16 — Typical weld preparation details for attachment of access tube to end plate

Annex ZA (informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of the Pressure Equipment Directive 97/23/EC with regard to **workmanship and construction**.

WARNING Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

The following clauses of this European Standard given in Table ZA-1 are likely to support essential safety requirements of the Pressure Equipment Directive 97/23/EC:

Table ZA.1 — Comparison between EN 12953-4 and Pressure Equipment Directive 97/23/EC with respect to workmanship and construction for shell boilers

EN 12953-4 harmonised clauses	Content	Pressure Equipment Directive 97/23/EC Annex I
5	Manufacturing procedures	3.1
5.15	Preparation of component parts	3.1.1
5.12	Joining — Freedom from surface or internal defects	3.1.2 1st paragr.
5.12	Joining — Properties of joints	3.1.2 2nd paragr.
5.16	Heat treatment	3.1.4
5.2	Traceability procedures	3.1.5

Compliance with the clauses of this European Standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

Bibliography

EN 473, *Non destructive testing - Qualification and certification of NDT personnel - General principles.*

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